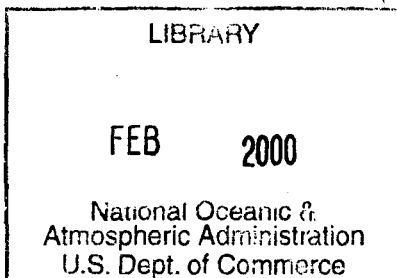


# INDIA WEATHER REVIEW, 1968

## ANNUAL SUMMARY

### PART-C



## STORMS & DEPRESSIONS

During the year 7 cyclonic storms and 5 depressions formed in the Bay of Bengal. One land depression also formed over Gangetic West Bengal. No storms or depressions either formed in the Arabian Sea or moved into this sea from the Bay of Bengal. The tracks of storms and depressions are given, separately in Fig. 1. The dates of activities of the storms and the greatest barometric depths observed near their centres are given in Table I below :

TABLE I

Locality	Month	Date	Greatest observed or estimated barometric depth (mb)
Bay of Bengal	May	7th - 10th	55
"	September	10th - 14th	18
"	Sept.-Oct.	29th - 4th	25
"	October	21st - 28th	48
"	November	2nd - 5th	16
"	November	9th - 15th	24
"	December	12th - 17th	16

The monthly distribution of the storms and depressions for the year 1968 is given in the Table II at the end.

The detailed descriptions of the storms and depressions are given below:

#### 1. Severe cyclonic storm in the Bay of Bengal - 7th to 10th May.

On the evening of 5th, a feeble cyclonic circulation extending upto 900 m.a.s.l. was moving westwards across lower Burma. By next morning there was fall of pressure all along the Arakan - Tenasserim coasts and the cyclonic circulation was emerging into the north Andaman Sea, where a trough of low also formed. By the evening of 6th, a well marked low pressure area formed over the north Andaman Sea. The pressure departures associated with the low were about -5mb, at 1730 IST of 6th. The circulation associated with the low extended upto about 3.0 km a.s.l. By the next morning, the well marked low pressure area concentrated into

QC  
990  
I37  
I52a  
pt.C  
1968

# **National Oceanic and Atmospheric Administration**

## **Environmental Data Rescue Program**

### **ERRATA NOTICE**

One or more conditions of the original document may affect the quality of the image, such as:

Discolored pages

Faded or light ink

Binding intrudes into the text

This document has been imaged through the NOAA Environmental Data Rescue Program. To view the original document, please contact the NOAA Central Library in Silver Spring, MD at (301) 713-2607 x124 or [www.reference@nodc.noaa.gov](mailto:www.reference@nodc.noaa.gov).

Information Manufacturing Corporation  
Imaging Subcontractor  
Rocket Center, West Virginia  
September 14, 1999

I N D I A   W E A T H E R   R E V I E W , 1 9 6 8 .

A N N U A L   S U M M A R Y

P A R T   C

S T O R M S   A N D   D E P R E S S I O N S

C O N T E N T S

I      Depressions and Cyclonic Storms

C 1 - C 18

depression with centre at 0830 IST near 14°N and 95.5°E. Widespread thundershowers were reported from the Bay Island Stations on the morning of this day. The pressure departures associated with the depression were about -7 mb. ESSA-6 satellite reported in the morning a vortex near 14°N 96.5°E with bands in all sectors. The cyclonic circulation associated with the depression extended upto 5.4 km a.s.l. It intensified into a deep depression during the course of the day and was centred near 14.5°N 95°E at 1730 IST of 7th. Rangoon reported wind SE/15 kt at 300 m, SE/20 kt at 600 m and SE/35 kt at 900 m a.s.l. at 1730 IST. The deep depression, moving in a northwesterly direction, further intensified into a cyclonic storm during the course of the night of 7th-8th and into a severe cyclonic storm on the morning of 8th. It was centred at 0830 IST of 8th near 15.5°N and 94°E. The following observations are of interest in this context :

Name of Ship/ Station	Position		Time IST.	Wind		Pressure (mb)	Weather
	Lat. °N	Long. °E		Direc- tion	Speed knots		
VWDG	15.7	90.2	0530	NW	5	1000.7	Overcast
PFHO	17.0	89.2	0530	N	5	1000.8	Overcast
SHIP (No name)	16.0	93.5	0730	NNE	45	992.1	-
Mayabandar			0830	SW	10	1002.5	Drizzle
Tavoy			0830	S	2	1005.8	Overcast
Bassein			0830	E	15	1000.3	Drizzle
IGQB	14.5	93.9	1130	WSW	30	998.0	Showers
Port Blair			0530	WSW	20 at 300 m.		
				W	30 at 600 m.		
				W	40 at 900 m.		
				W	25 at 1500 m.		
V. Point			0530	SSW	35 at 1500 m.		
Akyab			0530	E	5 at 300 m.		
				E	5 at 600 m.		
				E	10 at 900 m.		
				ENE	15 at 1500 m.		

ESSA-6 Satellite cloud pictures at 0954 IST of 8th showed a tropical vortex near 15.5°N, 94.5°E, central overcast about six degrees in diameter, more clouding to west and north and organised bands all sectors.

Moving in a westnorthwesterly direction, the storm was centred near 16.5°N 91.5°E at 1730 IST of 8th. Later moving slowly in a northerly direction, it was centred at 0830 IST of 9th near 17.5°N, 91.5°E. There were no ships' observations within a radius of three degrees from the centre of the storm. The following observations of 9th from the Arakan coast are however significant in this connection:

Name of ship/ station	Position		Time IST	Wind		Pressure (mb)	Weather
	Lat.	Long.		Direc- tion	Speed knots		
Akyab			1730	NE	5	1000.7	Drizzle
Kyaukpyu			1730	E	15	999.4	Rain
Sandoway			1730	SE	5	1002.0	Rain
Bassein			1730	SE	5	1003.9	Overcast
Coco Island			1730	SW	20	1003.9	Overcast

ESSA-6 Satellite picture at 1048 IST of 9th indicated that the severe cyclonic storm is centred near  $17.5^{\circ}\text{N}$ ,  $91.5^{\circ}\text{E}$  with spiral bands in all sectors and overcast area six degrees in diameter. The eye was also visible. A photograph of this frame is reproduced in Fig. 2. The storm could be classified as belonging to Stage X Cat 4 and the maximum wind associated with the system at this time works out to about 120 kt. Using Fletcher's formula, the central pressure of the system works out to 953 mb and the associated pressure defect to 55 mb. The storm started recurving towards the northeast and crossed the north Arakan coast near Akyab in the early morning of 10th and was centred at 0830 hrs IST of 10th about 10-15 km northeast of Akyab. ESSA-6 satellite pictures at 1051 IST of 10th indicated the system to be located near  $20.5^{\circ}\text{N}$ ,  $93^{\circ}\text{E}$ . Continuing to move northeastwards and weakening rapidly at the same time, it lay at 1730 IST of 10th as a depression with centre about 250 km northeast of Akyab. Later, it weakened further and moved away northeastwards.

later

Under the influence of this cyclonic storm, the monsoon advanced into the north Andaman Sea, the southeast Bay and the southern parts of southwest Bay of Bengal by the 8th. It also caused widespread rain in the Bay Islands with a few heavy falls from 5th to 7th. Some of the principal amounts of rainfall were : Long Island 7 cm and Port Blair 4 cm on 5th, Port Blair 8 cm and Maya Bandar and Hut Bay 7 cm each on 6th and Port Blair 7 cm and Long Island 6 cm on 7th.

According to press reports, the severe cyclonic storm with the tidal waters accompanying it took a toll of over 1,000 lives besides causing severe destruction in the southwest coast of Burma. The full force of the cyclone hit the coastal city of Akyab, 90% of which was heavily damaged. The Greek Freighter, "Geros Micharos" was also reported to have sunk in the open Seas.

## 2. Depression in the Bay of Bengal - 12th to 14th June;

A low pressure wave was moving westwards across the Arakan coast on the evening of 10th June. Under its influence, a low pressure area formed over the head Bay of Bengal and the adjoining land areas. It intensified into a depression by the morning of 12th with centre at 0830 IST near  $21.5^{\circ}\text{N}$   $89.5^{\circ}\text{E}$ . The cyclonic circulation associated with the depression extended upto 6.0 km a.s.l. Moving in a northerly direction, it crossed the West Bengal - East Pakistan coast by the early morning of 13th and was centred at 0830 IST of 13th near Khulna. ESSA-6 satellite pictures showed a cyclonic circulation near  $23^{\circ}\text{N}$ ,  $90^{\circ}\text{E}$  with bands in all sectors at 0922 IST of 13th. Continuing to move in a northerly direction, it was centred close to Pabna at 1730 IST of the same day. Moving thereafter in a westnorthwesterly direction and weakening, it lay over Gangetic West Bengal and adjoining Bihar as a low pressure area on 15th morning. It persisted there till 17th and later moved away eastwards across north Assam by the 20th. Under the influence of this depression, the monsoon extended into West Bengal, Bihar State and Orissa during the course of the second week of June. According to press reports, the continuous heavy rain in Assam during the third week led to serious floods there, causing severe damage to standing crops and disrupting traffic. About one million people were hit by the floods and a few people lost their lives. Some of the noteworthy amounts of rainfall associated with this system are : Alipore 8 cm and Sandheads 6 cm on 13th, Sandheads 5 cm on 14th, Balurghat 10 cm on 16th, Dhanbad 15 cm, Asansol 13 cm and Dum Dum 10 cm on 17th, Haflong 56 cm, Goalpara 22 cm, Dhubri 16 cm and Tangla 11 cm on 19th and Agartala 18 cm, Silchar 15 cm, Rangiya 13 cm and Tangla 11 cm on 20th.

at 0830 IST of 14th about 20 kms NNW of Faridpur. Later moving in a north-north-westerly direction it was centred

### 3. Deep land depression on - 9th to 11th July.

A low pressure area formed over Bihar Plateau and adjoining Gangetic West Bengal on 8th morning. It concentrated into a deep depression by the 9th, with centre at 0830 hrs IST about 30km southeast of Sriniketan. Moving in a northeasterly direction, it was centred at 0830 hrs IST of 10th about 30 km north of Faridpur (East Pakistan) and near Sirajganj (East Pakistan) at 1730 IST. The cyclonic circulation associated with the deep depression was extending upto 9.0 km a.s.l. at 1730 IST of 10th. Later, moving in a northerly direction, the deep depression was centred near Mymensingh at 0830 IST of 11th. Moving northeastwards, it weakened into a depression and was centred at 1730 IST of 11th about 100 km northwest of Mymensingh. It weakened into a depression and was lying over the northern parts of East Pakistan and adjoining Assam on 12th morning and moved away rapidly northeastwards across north Assam by the same evening.

Under the influence of this system, there was a spell of heavy rainfall in northeast India. Calcutta recorded 18 cm of rain on 9th, the heaviest in July during the last 50 years. The other significant amounts of rainfall were : Sibsagar 31 cm, Dhanbad 19 cm, Shillong 17 cm, Berhampore 13 cm and Kailashahar 12 cm on 8th, Krishnanagar 26 cm, Bagati 24 cm, Jamshedpur 18 cm and Bilaspur 12 cm on 9th, Daltonganj and Midnapore 13 cm each on 10th, Berhampore 17 cm, Aijal 14 cm and Krishnanagar 12 cm on 11th, Tura 8 cm on 12th and Tangla 17 cm and Tura 15 cm on 13th.

The heavy rains caused severe floods in West Bengal and 10 people were reported to have been killed and about 5 lakh people were affected by the floods there. The rivers in Assam also rose in spate and flooded vast areas.

### 4. Deep depressinn in the Bay of Bengal - 26th July to 2nd August.

On the morning of 23rd, an upper air cyclonic circulation extending between 3.0 and 5.4 km a.s.l. was lying over Thailand and adjoining Burma. By the evening of the same day, it was moving westwards into the Bay of Bengal across the Arakan coast. By the morning of 24th, a low pressure area formed over the central and adjoining north Bay of Bengal and it became well marked by the 25th. The circulation associated with the low extended upto 6.0 km a.s.l. The well marked low pressure area concentrated into a depression on 26th with centre at 0830 IST near 18°N, 88°E. There were no ships' reports from the vicinity of the depression to fix the centre more critically. However, ESSA-6 Satellite pictures at 1128 IST of 26th indicated a cyclonic circulation near 17.5°N 88.5°E. Moving in a northerly direction, the depression was centred near 19.5°N, 88°E at 0830 IST of 27th.

Continuing to move northwards, the depression intensified into a deep depression by 28th morning and was centred at 0830 IST near 20.5°N 88°E. The cyclonic circulation associated with the system extended upto 7.2 km a.s.l. on this day. By the evening of the same day, it was close to north Orissa coast about 50 km east-southeast of Chandbali. It crossed the north Orissa coast near Chandbali on the night of 28th - 29th and moving very rapidly westnorthwestwards, weakened into a depression, and lay at 0830 IST of 29th with its centre near Sambalpur. Continuing to move westnorthwestwards, it was centred about 20 km southeast of Jabalpur at 0830 IST of 30th and near Jhalawar at 0830 IST of the next day. Later, the depression moved northwest and was centred on the morning of 2nd about 80 km southeast of Jaipur. It later weakened into a low pressure area over northwest Madhya Pradesh and neighbourhood and became unimportant by the 4th.

at 0830 IST of 1st August about 70 km northwest of Kota. It then recurved towards the northeast and was centred

Under the influence of this system, the monsoon activity was well maintained generally over the country, particularly over the central parts of the country. The heavy rains were reported to have caused serious floods in east Rajasthan inundating vast areas and disrupting road and rail communications. Some of the noteworthy amounts of rainfall associated with this system were : Koraput 6 cm on 27th July, Phulbani 13 cm on 28th, Sambalpur 11 cm, Raipur 10 cm, Pendra 9 cm and Dum Dum 7 cm on 29th, Hoshangabad 23 cm, Gondia 19 cm, Seoni 15 cm, Pachmarhi 11 cm and Banswara 8 cm on 30th, Ratlam 11 cm, Bhopal 10 cm, Ujjain and Nimach 8 cm each and Indore 7 cm on 31st, Idar 28 cm, Banswara 27 cm, Abu 26 cm, Dungarpur 18 cm, Udaipur 9 cm and Rajkot 7 cm on 1st August, Abu 32 cm, Bhilwara 12 cm, Kota AP 11 cm and Udaipur 10 cm on 2nd and Rajgarh 15 cm on 3rd.

#### 5. Deep depression in the Bay of Bengal - 3rd to 8th August.

A low pressure wave from the east was moving westwards across the Arakan-Chittagong coasts on the morning of 1st as could be seen from the large fall of pressure over this area. By the next morning, a low pressure area formed over the north-east Bay of Bengal. It concentrated into a depression by the morning of 3rd with centre at 0830 IST near  $22^{\circ}\text{N}$ ,  $89.5^{\circ}\text{E}$ . ESSA-6 satellite pictures also showed a possible cyclonic circulation near  $22.5^{\circ}\text{N}$ ,  $89.0^{\circ}\text{E}$  on the morning of the same day. The cyclonic circulation associated with the depression extended upto 9.0 km a.s.l. Moving in a westerly direction, it was centred about 90 km west of Calcutta at 1730 IST of 3rd. Moving rapidly in the same direction and intensifying into a deep depression, it was lying over north Orissa and adjoining parts of east Madhya Pradesh and Bihar Plateau, with centre at 0830 IST of 4th about 100 km north of Jharsuguda. There was a pressure fall of 5-6 mb over Bihar Plateau and adjoining east Madhya Pradesh at 0830 IST of this day. ESSA-6 satellite picture showed an active cyclonic circulation near  $23^{\circ}\text{N}$ ,  $84^{\circ}\text{E}$  at 1144 IST of 4th. The easterlies to the north of the deep depression were about 35-40 kt at 0530 IST of this day upto 3.6 km a.s.l. and the cyclonic circulation extended to 10.5 km a.s.l. Gangetic West Bengal, Bihar Plateau and Orissa experienced widespread rainfall with a few heavy falls on 4th morning. Continuing to move westwards, the deep depression was centred near Pachmarhi, at 0830 IST of 5th. Chhindwara reported pressure of 991.8 mb at this time with a pressure departure of -10.1 mb. Madhya Pradesh and Vidarbha experienced widespread rain with scattered heavy to very heavy falls on this day. Moving further west, it was centred about 50 km east of Dohad and 50 km northnorthwest of Rajkot at 0830 IST of 6th and 7th respectively. ESSA-6 satellite pictures showed a vortex near  $22.5^{\circ}\text{N}$ ,  $75^{\circ}\text{E}$  with bands on all sectors at 0745 IST of 6th. Dohad reported the lowest pressure of 990.4 mb and Baroda 991.3 mb at 0830 IST of 6th with the departure from normal at Baroda being -12.3 mb. There was widespread heavy rainfall over Gujarat Region, north Madhya Maharashtra and adjoining parts of west Madhya Pradesh on the 6th. On the next day, Saurashtra and Kutch experienced very heavy rain. After 7th, the deep depression took a westnorthwesterly course and at the same time started weakening into a depression. Surface pressures over Saurashtra and Kutch had risen by the evening of 7th and the depression was centred at 1730 IST near Bhuj. Later moving in a northwesterly direction, the depression was centred about 30 km/south of Hyderabad (Sind) the same evening. Moving further northwestwards it weakened and merged into the seasonal low over West Pakistan by the next day. /northeast Naliya at 0830 IST and about 30 km

Under the influence of this system, the monsoon was active or vigorous in Gangetic West Bengal, Orissa, Bihar Plateau, Madhya Pradesh, Maharashtra and Gujarat State. Bhaunagar recorded an exceptionally heavy fall of 38 cm of rain and Porbandar 32 cm on 7th. The other noteworthy amounts of rainfall reported were : Jamshedpur 21 cm, Midnapore 17 cm, Dhanbad 15 cm, Alipore 13 cm and Contai 12 cm on 3rd, Baripada 26 cm, Jharsuguda 20 cm and Rourkela 14 cm on 4th, Pachmarhi 28 cm, Jalgaon

17 cm, Champa 14 cm and Khandwa 13 cm on 5th, Surat 21 cm, Jalgaon 19 cm, Baroda and Nandurbar 18 cm each, Nasik (Ozar) 15 cm and Khandwa 13 cm on 6th and Rajkot 19 cm, Mahabaleshwar and Khandala 15 cm each and Bhira 14 cm on 7th.

As a result of the heavy rains, serious floods were reported from north Orissa, West Bengal and Gujarat State causing inundation of vast areas, disruption of road and rail communications and damage to standing crops. The floods in Midnapore district alone affected about 5 lakhs of people. South Gujarat also suffered serious damages and loss of many lives, Broach and Surat being very seriously affected by the flood waters of the Narmada and Tapti respectively. The rail communication between Gujarat and Bombay was also cut off due to breaches of tracks and bridges and normal traffic could be restored only after about a month. Flood havoc due to the heavy rains were also reported from Madhya Pradesh, Haryana and parts of Uttar Pradesh.

#### 6. Depression in the Bay of Bengal - 11th to 14th August.

An upper air cyclonic circulation developed over the northeast Bay of Bengal on the evening of 7th and it was extending between 3.0 and 7.2 km a.s.l. There was a general fall of pressure over the Andaman Sea, north Bay of Bengal, northeast India and the East Pakistan-Burma coasts at this time. By the morning of 9th, a feeble low pressure area formed over the northeast Bay of Bengal and by the same evening, it became well marked. The pressure departures in the field of the low were about of -4 to -5 mb. The upper air cyclonic circulation associated with the low extended upto 7.2 km a.s.l. on 10th evening. By the next morning, the low pressure area concentrated into a depression, with centre at 0830 IST near  $22^{\circ}\text{N}$ ,  $90^{\circ}\text{E}$ . ESSA-6 satellite pictures showed a cyclonic circulation near  $22^{\circ}\text{N}$ ,  $90^{\circ}\text{E}$  at 1023 IST of 11th. Moving in a westnorthwesterly direction, it lay over Gangetic West Bengal with centre at 0830 IST of 12th about 20 km south of Burdwan. Continuing its west-northwesterly movement, it was centred about 110 km southsoutheast of Daltonganj at 0830 IST of 13th and 50 km northwest of Ambikapur at 0830 IST of 14th. It was more or less stationary till the evening of 14th and later weakened into a low pressure area over northeast Madhya Pradesh. It persisted there till 18th and later merged into the seasonal trough.

Under its influence, the monsoon was active in Gangetic West Bengal on 12th in Madhya Pradesh and Vidarbha on 14th and in west Madhya Pradesh on 15th, 16th and 17th. Widespread rainfall was also reported from Orissa, Uttar Pradesh and East Rajasthan. Some of the heavy amounts of rainfall reported were : Moradabad 16 cm and Karnal 12 cm on 11th, Baripada and Sambalpur 16 cm each on 12th, Silchar 13 cm, Champa 12 cm and Rewa 7 cm on 13th, Mandla 21 cm, Seoni 15 cm, Jabalpur 14 cm and Gondia 11 cm on 14th, Moradabad 12 cm on 15th and Nowgong 18 cm and Pachmarhi 10 cm on 16th.

The heavy rains were reported to have caused floods in Wainganga and its tributaries and in the Narmada in Madhya Pradesh and the road traffic was dislocated from 14th to 18th. Moderate floods were also reported in the rivers Sarda, Ramganga and Ganga in Uttar Pradesh during the third week.

#### 7. Depression in the Bay of Bengal - 22nd to 24th August.

On the 1st morning of 18th, there was fall of pressures along the Arakan-Tennasserim coasts, suggesting the westward movement of a low pressure wave across central Burma. By 19th morning, the pressure fall was more concentrated along the Arakan coast and the northeast Bay of Bengal. By the same evening, a trough of low pressure developed over the northeast Bay of Bengal. An upper air cyclonic circula-

tion extending between 1.5 and 4.5 km a.s.l. had also developed over the northeast and adjoining east central Bay of Bengal at the same time. On the 20th morning, the trough was more marked and by the same evening, a low pressure area formed over the north Bay which became well marked on the 21st morning. The cyclonic circulation associated with the low extended upto 5.4 km a.s.l. It concentrated into a depression by the evening of 22nd, with centre at 1730 IST near  $19.5^{\circ}\text{N}$ ,  $90^{\circ}\text{E}$ . The following observations of 22nd August are of interest in this connection :

Name of ship/ station	Position		Time IST	Wind		Pressure (mb)	Weather
	Lat. $^{\circ}\text{N}$	Long. $^{\circ}\text{E}$		Direc- tion	Speed knots		
PGBU	20.2	90.1	1730	E	10	995.1	Rain
Sandheads			1730	NNE	10	997.1	Mainly overcast
Akyab			1730	S	10	999.3	- do -
Chittagong			1730	S	5	998.7	- do -
Calcutta			1730	E	5	997.6	Partly cloudy

The cyclonic circulation associated with the system extended upto 6.0 km a.s.l. at this time. Moving rapidly northwestwards, the depression lay close to West Bengal coast on 23rd with centre at 0830 IST near  $21.5^{\circ}\text{N}$ ,  $88.5^{\circ}\text{E}$ . Crossing the West Bengal coast near Sagar Island during the course of the day, it was centred about 60 km southsouthwest of Calcutta at 1730 IST of the 23rd. Later moving in a northerly direction, it lay over Gangetic West Bengal on the 24th with centre at 0830 IST about 40 km east of Berhampore. It weakened into a low pressure area by the evening of the same day over the central parts of West Bengal and on 25th morning was lying over Sub-Himalayan West Bengal and became less marked afterwards. Under its influence, widespread rainfall occurred in Orissa and Bihar State on 23rd, in the whole of northeast India on the 24th, 25th and 26th and in Assam and Sub-Himalayan West Bengal on the 27th.

Some of the noteworthy amounts of rainfall associated with this system were : Silchar 14 cm and Jharsuguda 7 cm on 23rd, Alipore and Purnea 6 cm on 24th, Tura 7 cm and Balasore 6 cm on 25th, Tura 14 cm, Malda 9 cm, Cooch Behar and Purnea 7 cm each, Sriniketan 6 cm and Mohanbari 5 cm on 26th and Goalpara 13 cm, Tura, Shillong and Darjeeling 6 cm each and Jalpaiguri, Forbesganj and Dum Dum 5 cm each on 27th.

#### 8. Cyclonic storm in the Bay of Bengal - 10th to 14th September.

An upper air cyclonic circulation developed over the central and adjoining south Bay of Bengal between 4.5 and 6.0 km a.s.l. on the 2nd. This circulation descended to 3.0 km a.s.l. on 3rd. By 7th morning, the circulation could be seen from the very low levels. On the 8th morning, a feeble trough of low developed over the northwest Bay of Bengal and a low pressure area formed over the same area on 9th morning. The low pressure area concentrated into a depression on 10th, with centre at 0830 IST near  $19^{\circ}\text{N}$ ,  $91^{\circ}\text{E}$ . The circulation associated with the low extended to 7.2 km a.s.l. Moving in a westnorthwesterly direction, the depression was centred at 1730 IST of the same day near  $19.5^{\circ}\text{N}$ ,  $89.5^{\circ}\text{E}$ .

Continuing its westnorthwesterly movement, the depression intensified into a deep depression during the course of night and was lying over the head Bay of Bengal on 11th with centre at 0830 IST near 20°N, 88.5°E. In this connection the following observations of 11th are of interest :

Name of ship/ station	Position		Time IST	Wind		Pressure (mb)	Weather
	Lat. °N	Long. °E		Direc- tion	Speed knots		
VWCF	17.2	86.5	0530	W	20	998.8	Showers
Sandheads			0830	E	20	999.3	Drizzle
Sagar Island			0830	NNE	15	998.6	Partly cloudy
Puri			0830	NW	5	999.7	Rain
Gopalpur			0830	Calm		1000.0	Overcast
Sandoway			0830	S	5	1004.2	Mainly overcast
Akyab			0830	E	10	1001.7	Drizzle
Calcutta			0530	ENE	20 at 300 m		
				ENE	30 at 600 m		
				ENE	30 at 900 m		
				E	25 at 1500 m		
Cuttack			0530	NW	20 at 300 m		
				N	20 at 600 m		
				N	20 at 900 m		
				N	20 at 1500 m		

Moving further westwards, the deep depression was centred at 1730 IST of 11th near 20°N, 87.5°E. Sandheads (position 129 km north of normal position) reported surface pressure 993.7 mb and surface wind ESE/25 kt at 1730 IST of this day and the corresponding pressure defect was 8.8 mb. Moving in a westsouthwesterly direction, the deep depression intensified into a cyclonic storm during the course of the night and was centred at 0830 IST of 12th close to Orissa coast near Gopalpur. Gopalpur recorded the lowest pressure of 989.5 mb at 0830 IST of 12th. The 24-hours pressure defect was 16.0 mb. ESSA-6 satellite picture of 1012 IST of 12th showed a vortex near 19.2°N, 85.3°E with eye about half a degree in diameter clearly seen. The storm crossed the Orissa coast near Gopalpur in the evening and was centred at 1730 IST of 12th about 20 km north of Gopalpur. Moving in a northwesterly direction, it weakened into a deep depression and was centred at 0830 IST of 13th about 80 km ESE of Titlagarh. At this time the circulation associated with the system extended upto 6.0 km a.s.l. only. The deep depression weakened further into a depression without any appreciable movement. The pressures in the depression field had started rising at this time and the cyclonic circulation hardly extended to 4.5 km a.s.l. and above this level. It moved westnorthwestwards and lay centred at 0830 IST of 14th about 100 km east of Kanker in east Madhya Pradesh. There was a further rise of pressure in the depression field and the system weakened into a low pressure area by the same evening over east Madhya Pradesh. The low persisted over east Madhya Pradesh for the next two days and later shifted to north Madhya Pradesh and adjoining Uttar Pradesh where it persisted till 20th. It became less marked thereafter. [at Gopalpur at this time was -10.5 mb and the corresponding

In association with this system, there was good rainfall over the Peninsula, the central parts of the country, northeast India and east Uttar Pradesh. Some of the heavy falls recorded were : Gopalpur 29 cm, Chandbali 21 cm, Bhubaneswar 16 cm, Puri 15 cm and Bhawani Patna 11 cm on 12th, Phulbani 14 cm, Kanker and Bhawani Patna 12 cm each, Jagdalpur 11 cm and Raipur 10 cm on 13th, Gondia 15 cm and Chhindwara 10 cm on 14th, Pachmarhi 26 cm, Chhindwara 13 cm and Betul 9 cm on 15th, Umaria 9 cm on 16th, Raigarh 11 cm and Jashpurnagar 9 cm on 17th, Orai 19 cm on 18th and Moradabad 10 cm on 19th.

#### 9. Severe cyclonic storm in the Bay of Bengal - 29th Sept. to 4th Oct.

An upper air cyclonic circulation extending between 1.5 and 7.2 km a.s.l. was lying over Gulf of Siam and adjoining areas of Thailand and south Burma on the morning of 23rd. On 25th, it was lying over the north Andaman Sea and Tennasserim area. By the next day, the circulation could be seen in the very low levels also. A trough of low was also noticed on the surface charts at 0830 IST of this day over the Andaman Sea and adjoining Tennasserim area. On 27th morning, a feeble low pressure area developed over the north Andaman Sea and the associated cyclonic circulation extended upto 6.0 km a.s.l. An east-west trough line was running along 12°N, at 5.4 km a.s.l. from Kerala to the Gulf of Siam. The low pressure area moved into the east central Bay of Bengal on the morning of 28th. By the morning of 29th, it became well marked and concentrated into a depression by the evening with centre at 1730 IST near 15°N, 91°E. Moving in a northwesterly direction, it was centred at 0830 IST of 30th near 16°N, 89.5°E. The following observations of 30th are of interest in this connection :

Name of ship/ station	Position		Time IST	Wind		Pressure (mb)	Weather
	Lat. °N	Long. °E		Direc- tion	Speed knots		
VWBT	15.0	85.5	0530			1005.3	Showers
GMSN	11.0	85.5	0530	SW	10	1005.2	Rain
VWXD	18.1	91.2	1130	SSE	15	1005.0	Partly cloudy
Indian Strength	17.1	86.3	1130	ENE	10	1006.5	Overcast
Jalakrishna	13.9	85.0	1130	W	2	1005.8	Overcast
Port Blair			0830	SW	5	1009.7	Mainly cloudy
Coco Island			0830	SW	15	1009.2	Overcast
Sandheads			0830	NE	5	1008.7	Partly cloudy

ESSA-6 satellite pictures of 0902 IST of 30th showed an active cyclonic circulation near 16°N, 89°E with bands all sectors. Continuing its northwesterly direction it was centred at 1730 IST near 16.5°N, 88.5°E. The depression was probably deep at this time. Moving further northwestwards, the deep depression intensified into a cyclonic storm during the course of the night and was centred at 0830 IST of 1st October near 17°N, 87°E. The following observations of 1st are significant in this context :

Name of ship/ station	Position		Time IST	Wind		Pressure (mb)	Weather
	Lat. °N	Long. °E		Direc- tion	Speed knots		
Indian Trust	18.1	85.5	0530	NE	20	1002.2	Rain
VWLN	19.4	86.3	1130	NE	30	1002.2	Showers
Sandheads			0830	E	30	1004.3	Partly cloudy
Chandbali			0830	NE	10	1004.9	- do -
Gopalpur			0830	N	10	1004.4	Rain
Kalingapatnam			0830	NNW	2	1004.2	Rain
Vishakhapatnam			0830	W	2	1005.4	Rain
Akyab			0830	SSE	5	1008.8	Drizzle
Cox's Bazar			0830	SE	10	1009.2	Mainly overcast

Though the pressures were falling all over the country, larger pressure falls of 2-4 mb were noticed along Andhra-Orissa coasts at this time and the pressure departures along these coasts were about -4 to -5 mb. ESSA-6 Satellite picture showed vortex at 0955 IST of 1st near 17°N, 87°E with overcast Cb and heavy Ci clouds all around. The storm was centred at 1730 IST of 1st near 18°N, 85.5°E. The overcast clouds began to 1730 IST of 1st.

Pressure continued to fall along the Andhra-Orissa coasts and the maximum falls of 6-7 mb were reported from Gopalpur and Kalingapatnam. Kalingapatnam reported a pressure defect of 8.7 mb and Gopalpur 7.7 mb at 1730 IST of this day. Upper winds at Cuttack were ENE/25 kt, ENE/30 kt and ENE/25 kt at 300, 600 and 900 metres respectively and at Vishakhapatnam W/15 kt, WSW 15 kt and WSW/20 kt at 300, 600 and 900 metres respectively at 1730 IST of 1st. Maintaining its northwesterly movement, it further intensified into a severe cyclonic storm and was centred very close to north Andhra coast near Kalingapatnam at 0830 IST of 2nd. The following observations of 2nd are of interest in this instance :

Name of ship/ station	Position		Time IST	Wind		Pressure (mb)	Weather
	Lat. °N	Long. °E		Direc- tion	Speed knots		
VWBS	18.9	85.5	0530	SE	25	994.3	Squall
VWBS	18.2	85.1	1130	S	25	997.3	Rain
Gopalpur			0830	SE	30	997.3	Rain
Kalingapatnam			0830	Variable		986.2	Thundershowers
Vishakhapatnam			0830	WSW	15	996.1	Rain
Vishakhapatnam			0530	WNW	20 at 300 m		
				WNW	25 at 600 m		
				NW	40 at 900 m		
				NW	35 at 1500 m		

Gopalpur, Kalingapatnam and Vishakhapatnam reported -7.1, -18.0 and -8.0 mb 24 hours pressure changes respectively at 0830 IST of 2nd and the pressure departures from normal were -12.1 mb. at Gopalpur, -22.4 mb at Kalingapatnam and -12.9 mb at Vishakhapatnam at the same hour. ESSA-6 Satellite pictures showed a vortex near  $18^{\circ}\text{N}$ ,  $83.5^{\circ}\text{E}$  at 1049 IST of 2nd. The severe cyclonic storm crossed north Andhra coast near Kalingapatnam during the forenoon of 2nd, weakened into a cyclonic storm and was centred at 1730 IST of 2nd about 100 km northwest of Kalingapatnam. Later, moving in a northerly direction, it was centred near Titlagarh at 0830 IST of 3rd. Titlagarh reported the lowest pressure of 993.9 mb at this time and the corresponding pressure defect was 13.4 mb. Maintaining its northerly course, the cyclonic storm weakened into a deep depression and was centred at 1730 IST of 3rd near Bolangir in Orissa. Moving rather rapidly afterwards, it was lying over the western parts of Bihar State with centre near Dehri at 0830 IST of 4th. Weakening further into a depression, it was centred near Arrah (Bihar Plains) at 1730 IST of the same day. Moving further northwards and weakening, it broke up over the Nepal Himalayas by the 5th.

The storm was at its maximum intensity on 2nd morning. As per ESSA-6 Satellite pictures of this day, the central overcast area associated with the storm was about five degrees in diameter and the storm could be classified as one belonging to Stage X Cat.

2. This gives a maximum wind associated with the storm to be of the order of 70kt/hour. Using Fletcher's formula, the central pressure works out to be 984 mb. The estimated pressure defect at the centre of the storm was about 25 mb on 2nd morning.

Under the influence of this cyclonic storm, there was unusually heavy rain over northeast India. East Madhya Pradesh and east Uttar Pradesh also received good rainfall. Exceptionally heavy rains occurred over Sub-Himalayan West Bengal and adjoining Bihar Plains and Assam and in Sikkim from the evening of 2nd to the morning of 5th. Some of the noteworthy amounts of rainfall were : Pedong 60 cm on 2nd, Pedong 100 cm, Sankas 76 cm, Sivok 37 cm and Labha 32 cm on 3rd, Pedong 70 cm, Sankas 64 cm and Sivok 37 cm on 4th, Sankas 40 cm, Baghdogra 35 cm, Cooch Behar, Teesta Bridge and Musong 29 cm each and Darjeeling, Rongo and Rassisum 28 cm each on 5th. The other noteworthy amounts of rainfall were : Baghdogra 18 cm, Jalpaiguri 12 cm, Waltair and Jagdalpur 8 cm each and Kalimpong and Dum Dum 7 cm each on 3rd, Darjeeling 21 cm, Kalimpong 17 cm, Baghdogra 15 cm, Cooch Behar 12 cm, Jalpaiguri 11 cm and Goalpara 16 cm on 4th, and Dhubri 16 cm, Forbesganj 14 cm and Purnea 12 cm on 5th.

The continuous heavy rains led to serious floods and land slides in Darjeeling, Jalpaiguri and Cooch Behar districts of West Bengal and according to press reports, about 1,000 people lost their lives and many villages were wiped out by the flood waters. The flood waters of the rivers in north Bihar and north Assam also inundated vast areas causing much devastation.

#### 10. Severe cyclonic storm in the Bay of Bengal - 21st to 28th October.

An upper air cyclonic circulation extending upto 3.6 km a.s.l. was lying over the Gulf of Siam on the 16th. By next morning it moved into the Andaman Sea, where a feeble low pressure area formed. Moving westwards, the low was lying over southeast Bay of Bengal and adjoining south Andaman Sea. On 20th morning, it became well marked and concentrated into a depression by the morning of 21st with centre at 0830 IST near  $11^{\circ}\text{N}$ ,  $86^{\circ}\text{E}$ . Moving westwards, it intensified into a depression with centre at 0830 IST of 22nd near  $11^{\circ}\text{N}$ ,  $86.5^{\circ}\text{E}$ . In this connection the following observations of 22nd are of interest :

/ deep

Name of ship/ station	Position		Time	Wind		Pressure ( mb )	Weather
	Lat. °N	Long. °E		Direc- tion	Speed knots		
ATAE	13.1	88.8	0530	E	20	1008.6	Partly cloudy
GMSN	7.6	87.8	0530	WSW	10	1007.0	- do -
VWWS	12.7	84.4	0700	NE	20	1008.2	Rain
GDZV	11.2	84.6	1130			1005.9	Rain
Port Blair			0830	E	2	1011.0	Mainly overcast

Moving further westwards, the deep depression was centred at 1730 IST near 11°N, 85.5°E. Taking a westnorthwesterly course, the deep depression further intensified into a cyclonic storm and was centred at 0830 IST of 23rd near 11.5°N, 83.5°E. ESSA-6 satellite pictures of 1024 IST of 23rd showed a vortex near 11.5°N, 83°E and some amount of banding seen. The following observations of 23rd are also of interest in this connection :

Name of ship/ station	Position		Time IST	Wind		Pressure (mb)	Weather
	Lat. °N	Long. °E		Direc- tion	Speed knots		
GMSM	9.2	83.3	0530	W	15	1004.3	Showers
GMSM	9.3	83.1	0630	W	15	1004.8	Showers
GMSM	9.2	83.0	0730	WNW	15	1006.9	Rain
GMSM	9.2	83.7	0830	WNW	15	1007.6	Rain
Madras			0830	N	10	1009.6	Overcast
Trincomalee			0830	WNW	5	1008.8	Mainly overcast
S.S.Shujaat	10.6	83.7	0905	WSW	35		Overcast
GMSM	9.2	83.7	0930	W	15	1007.5	Rain
SDIK	11.3	82.6	1000	NW	35	1005.0	Overcast
VWDD	9.8	81.5	1130	NW	25	1008.1	Overcast

Thereafter, moving in a northwesterly direction, the cyclonic storm further intensified into a severe cyclonic storm with a core of hurricane winds and was centred at 1730 IST of 23rd near 12°N, 83°E. A number of ships two degrees away both on the eastern and western sides of the storm reported winds of the order of 30-35 kt. Bulletin from U.S. Weather Bureau, Washington indicated pressure of a system at 23/0941 GMT Stage X, Cat 2, Diameter 3 near 11.5°N, 82.5°E

Taking a northnorthwesterly course, the severe cyclonic storm was centred at 0830 IST of 24th near 12.5°N, 82.5°E. Ship S.S. Jalavijaya position at 12.3°N, 84.5°E reported southerly wind 60 kt at 0730, 0830 and 0930 IST and 1030 IST on this day. ESSA-6 satellite pictures also showed a Vortex near 12.5°N, 82.5°E at 0928 IST of 24th with spiral bandings. The upper winds at Madras were NW/30 kt,

NNW/50 kt and N/35 kt at 300, 600, 900 and 1500 m a.s.l. at 0530 IST of this day. Moving further northwards, the severe cyclonic storm was centred near  $13.5^{\circ}\text{N}$ ,  $82.5^{\circ}\text{E}$  at 1730 IST of 24th. Bulletin from U.S. Weather Bureau, Washington based on ESSA-7 data of 24/084/GMT reported a Stage X Cat. 3 system of diameter 3 degrees with small ragged eye visible centre  $13^{\circ}\text{N}$ ,  $82.5^{\circ}\text{E}$ . Moving in a northnortheasterly direction, the storm was centred at 0830 IST of 25th near  $14^{\circ}\text{N}$ ,  $83^{\circ}\text{E}$ . ESSA-6 satellite pictures showed vortex near  $14^{\circ}\text{N}$ ,  $83.5^{\circ}\text{E}$  at 1015 IST of 25th, eye visible, half to one degree wide, central overcast 4-5 diameter and light spiral bandings in all sectors. Maintaining its northnortheasterly movement, the storm was centred at 0830 IST of 26th near  $16^{\circ}\text{N}$ ,  $84^{\circ}\text{E}$ . Ship YTCH at  $16^{\circ}\text{N}$ ,  $85.2^{\circ}\text{E}$  reported wind SE/35 kt and pressure 997.5 mb at 0530 IST and at  $16.2^{\circ}\text{N}$ ,  $85.5^{\circ}\text{E}$ , wind S/45 kt and pressure 999.8 mb at 1130 IST on 26th. Pressures were falling over the north Andhra coast and the departures at Vishakhapatnam and Kakinada were -6.5 and -6.4 mb respectively at 0830 IST of 26th. By 1730 IST of 26th the severe storm was centred near  $18^{\circ}\text{N}$ ,  $84^{\circ}\text{E}$ . Bulletin from U.S. Weather Bureau, Washington reported a system at 26/0830 GMT near  $17.5^{\circ}\text{N}$ ,  $84^{\circ}\text{E}$ , Stage X, Diameter 4 Cat. 4, with eye visible. On the morning of 27th, the storm was centred close to Orissa coast about 20 km southwest of Gopalpur, which reported surface wind southsoutheast 35 kt and pressure 1002.2 mb at 0830 IST on this day. The corresponding pressure defect at Gopalpur at this time was 11.1 mb. ESSA-6 satellite pictures at 1008 IST of 27th showed that the centre of the storm to be near  $18.5^{\circ}\text{N}$ ,  $85.5^{\circ}\text{E}$  with an overcast area of five degrees in diameter. The eye was also clearly seen. The storm moved along the Orissa coast very slowly and by 1730 IST of 27th was lying very close to Gopalpur. The surface wind at Gopalpur was northeast/35 kt and pressure 983.7 mb (pressure defect 26.1 mb) at 1730 IST of this day. By the next morning, it was centred about 30-40 km northnortheast of Gopalpur. There was rise of pressure in the storm field and the circulation associated with the storm did not extend beyond 6 km a.s.l. The satellite pictures also showed that the cloud field associated with the storm had shrunk very much at this time / the storm was weakening. By that evening, it weakened very rapidly into a trough of low over Orissa and the upper air cyclonic circulation was seen only upto 4.5 km a.s.l. This circulation also weakened into an upper level trough next morning, which became unimportant by 30th. From the satellite cloud report of 26th, the storm could be classified as one belonging to Stage X category 4, diameter of overcast area 4 degrees, which gives a maximum wind associated with the storm to be of the order of 105 kt. Using Fletcher's formula, the central pressure associated with the storm works out to 964 mb and the corresponding pressure defect was about 48 mb.

ESSA-6 Satellite picture - orbit 4405-1013 IST of 27th October 1968 is reproduced in Fig. 3.

The D.P.T. Anemogram and Barogram of Gopalpur for 27 - 28 October are reproduced in Fig. 4 and 5. It will be seen from the anemogram that the wind veered from easterly to southerly between 0500 and 1030 IST of 27th. Thereafter, the wind suddenly backed to northeasterly and remained so till mid-night. This would suggest that the storm moved very close to coast just south of Gopalpur and by 1030 IST, appears to have again moved along the coast northwards. From the barogram, it will be seen that the pressure at Gopalpur was at its lowest value from 1345 to 2145 IST of 27th, suggesting that the storm moved very slowly along the coast.

Under the influence of this severe cyclonic storm, very heavy rains occurred in coastal Orissa and adjoining coastal Andhra Pradesh on 27th and 28th. Some of the heavy rainfall amounts are : Gopalpur 32 cm, Puri 20 cm, Kalingapattam 18 cm and Bhubaneswar 8 cm on 27th, Bhubaneswar 22 cm, Gopalpur and Puri 21 cm each and Cuttack 17 cm on 28th and Gopalpur 12 cm on 29th.

The cyclonic storm left a trail of devastation in the coastal districts of Ganjam, Puri and Cuttack. The flood waters from the Chilka lake affected a number of villages on its banks and inundated vast areas of paddy fields. A number of persons lost their lives and thousands of heads of cattle perished. Road and rail communications were completely disrupted due to breaches.

# 11. Cyclonic storm in the Bay of Bengal - 2nd to 5th November.

A low pressure wave from the east moved into the Andaman Sea on the morning of 28th as could be inferred from the fall of Pressure over the south Burma coast and the Bay Islands. By the next day, it moved into the southeast Bay of Bengal and on 30th, a low pressure area formed over the southeast Bay. By 31st, it moved into the southwest Bay. On 1st morning it was well marked. The low concentrated into a depression on the morning of 2nd with centre at 0830 IST near 11.5°N, 86°E. On the morning of 3rd, it intensified into a deep depression and was centred at 0830 IST near 11.5°N, 85.5°E. ESSA-6 Satellite picture at 1032 IST of 2nd showed a cyclonic circulation near 12°N, 85°E. Moving in a northwesterly direction, it was centred near 12°N, 84°E at 0830 IST of 4th. ESSA-6 Satellite reported a vortex near 12.3°N, 83.3°E at 0936 IST of 4th with spiral bandings all around. Continuing to move northwestwards, the deep depression further intensified into a cyclonic storm and was centred at 1730 IST of 4th near 13°N, 82.5°E. The following observations of 4th are significant in this context :

Name of ship/ station	Position		Time IST	Wind		Pressure (mb)	Weather
	Lat. °N	Long. °E		Direc- tion	Speed knots		
QKQL	14.1	82.4	1730	NE	45	1002.0	Rain
VWNV	12.2	81.3	1730	NW	30	1002.5	Overcast
Madras			1730	N	15	1006.5	Overcast
Madras			1730	N	35 at 300 m 35 at 600 m 35 at 900 m 30 at 1500 m		
Nagapattinam			1730	NNE N N N	20 at 300 m 25 at 600 m 25 at 900 m 25 at 1500 m		

The circulation associated with the system extended upto 6.0 km a.s.l. Continuing its northwesterly movement, the storm was centred close to Madras - Andhra coasts about 30 km southeast of Nellore at 0830 IST of 5th. Nellore reported surface pressure of 1003.2 mb at this time and the corresponding pressure departure was -9.1 mb. ESSA-6 Satellite reported the centre of the vortex near 14.5°N, 79.2°E at 1014 IST of 5th with tight bandings all around. It was categorised as Stage X Cat.2 and central overcast area about three degrees in diameter. The circulation associated with the system extended upto 7.2 km a.s.l. at this time. The storm crossed the south Andhra coast near Nellore during the forenoon of 5th and weakened rapidly. There was a general rise of pressure all over the country by the evening and the system could not be traced on the surface chart. It however, lay as an upper air cyclonic circulation over the central Peninsula extending upto 20 km a.s.l. and with a

southwesterly tilt in the higher levels upto 4.5 km a.s.l. This circulation was lying over interior Mysore on the morning of 6th. It emerged into the east central Arabian Sea by 6th evening, where a well marked low pressure area formed the next day. This low pressure area moved away westwards across the central parts of the Arabian Sea by the 10th.

Under the influence of this system, there was widespread rain in coastal Andhra Pradesh on 5th and 6th and in Rayalaseema on 6th. Madras State experienced fairly widespread rain or thundershowers on 7th. Fairly widespread rain or thundershowers also occurred in Marathwada, Madhya Maharashtra, Madras State and north Interior Mysore on 8th. Masulipatam recorded an exceptionally heavy fall of 46 cm of rain on 6th. The other noteworthy amounts of rainfall were : Nellore 10 cm on 5th, Gannavaram 12 cm, Pondicherry 8 cm and Cuddapah 5 cm on 6th, Gadag, Ongole and Mysore 4 cm each on 7th and Coimbatore AP 8 cm, Chikalathana 6 cm and Nizamabad, Tuticorin, Pondicherry and Aurangabad 5 cm each on 8th.

Based on the satellite reports, the maximum wind associated with this storm works out to be 60 km/hr. Utilising Fletcher's formula, the central pressure at 0830 IST of 5th, works out to 996 mb. and the corresponding pressure defect would be 16 mb.

## 12. Severe cyclonic storm in the Bay of Bengal - 9th to 15th Nov.

A low pressure wave from the east moved into the Andaman Sea on the 7th. It moved into the southeast Bay of Bengal, where a low pressure area formed on the morning of 8th. It became well marked by the same evening. The low concentrated into a depression the next morning with centre at 0830 IST of 9th near  $9^{\circ}\text{N}$ ,  $89^{\circ}\text{E}$ . Moving in a northwesterly direction, it intensified into a deep depression with centre at 1730 IST of 9th near  $11^{\circ}\text{N}$ ,  $87^{\circ}\text{E}$ . Continuing its northwesterly movement, the deep depression further intensified into a severe cyclonic storm centred at 0830 IST of 10th near  $12.5^{\circ}\text{N}$ ,  $85.5^{\circ}\text{E}$ . The following observations of 10th are of interest in this connection :

Name of ship/ station	Position		Time	Wind		Pressure (mb)	Weather
	Lat. $^{\circ}\text{N}$	Long. $^{\circ}\text{E}$		Direc- tion	Speed knots		
VWRC	12.0	84.2	0530	NNW	20	1003.7	Showers
VWZW	14.6	85.4	0530	ENE	45	1004.0	Rain
VWRC	11.7	84.0	0830	WNW	20	1007.0	Overcast
Vishakhapatnam			0530	NNE	40 at 300 m		
				NNE	35 at 600 m		
				ENE	20 at 900 m		
				NNE	30 at 1500 m		
Madras			0530	N	20 at 300 m		
				N	20 at 600 m		
				NNE	25 at 900 m		
				NNE	25 at 1500 m		
Port Blair			0530	S	15 at 300 m		
				SSE	20 at 600 m		
				SSE	25 at 900 m		
				SSE	25 at 1500 m		

Maintaining its northwesterly movement, the severe cyclonic storm was centred at 0830 IST of 11th near  $14^{\circ}\text{N}$ ,  $84^{\circ}\text{E}$ . ESSA-6 satellite picture of 1007 IST of 11th showed vortex near  $14^{\circ}\text{N}$ ,  $84^{\circ}\text{E}$  stage X Cat.4, diameter 4 degrees, eye clearly visible and tight bands all sectors. Pressures were falling by about 2 mb along Andhra coast at this time and the departures were about -2 to -3 mb there. The upper air cyclonic circulation associated with the system was extending upto 7.2 km a.s.l. There were no ships observations in the storm field at 1730 IST to fix the position of the storm correctly. However, report from ESSA, USA read "ESSA-7 - 11/0951 GMT -  $15^{\circ}\text{N}$ ,  $83.5^{\circ}\text{E}$  Stage X, Cat 2.5 diameter 4. Eye apparently forming since yesterday".

After the evening of 11th, the severe storm began to recurve and moving in a northnortheasterly direction, it was centred at 0830 IST of 12th near  $16^{\circ}\text{N}$ ,  $84^{\circ}\text{E}$ . Ship PICG position  $16.9^{\circ}\text{N}$ ,  $85.1^{\circ}\text{E}$  reported surface winds S/50 kt, pressure 1004.5 mb and showers, at 1130 IST. Over the land, Vishakhapatnam reported the lowest pressure of 1006.5, surface wind northnortheast/20 kt and rain at 0830 IST. The 24-hours pressure change at Vishakhapatnam was -5.1 mb and the corresponding pressure defect was 7.4 mb at this hour. ESSA-6 Satellite picture of 1100 IST of 12th showed a vortex near  $16.8^{\circ}\text{N}$ ,  $84.5^{\circ}\text{E}$  - stage X Cat 3, diameter 3-4 degrees bands seen all around and no eye visible. Continuing its northnortheasterly movement, the storm was centred at 0830 IST of 13th near  $19^{\circ}\text{N}$ ,  $85.5^{\circ}\text{E}$ . The 24 hour pressure falls were confined only to a very small area over Orissa coast and Gopalpur and Chandbali were the only two stations that reported a fall of 3 and 4 mb respectively at 0830 IST of this day.

The cloud coverage had also comparatively shrunk at this time. The storm was probably showing signs of weakening at this stage. By the evening of 13th, it had weakened into a cyclonic storm and was located near  $20^{\circ}\text{N}$ ,  $87^{\circ}\text{E}$  and near  $20.5^{\circ}\text{N}$ ,  $87.5^{\circ}\text{E}$  at 0830 IST of 14th. It crossed the West Bengal Coast near Sagar Island during the night of 14-15th and weakened into a depression which was centred at 0830 IST of 15th about 100 km south-east of Calcutta. There was a rise of pressure all over the country on the morning of 15th and the depression later weakened into a low pressure area by the evening and was lying over East Pakistan. The circulation associated with the depression hardly extended to 2.1 km a.s.l. at this time. The low moved away northeastwards across south Assam by the 17th.

Based on satellite reports, the maximum wind associated with this storm was about 75 kt on 12th. Using Fletcher's formula, the lowest pressure associated with the system was 990 mb and the corresponding pressure defect was about 24 mb.

Under the influence of this severe cyclonic storm, there was heavy rainfall over the coastal areas of Orissa and adjoining coastal Andhra Pradesh and of Gangetic West Bengal and in south Assam. Some of the heavy amounts of rainfall were : Gopalpur 14 cm, Kalingapatnam 12 cm, Puri 11 cm and Bhubaneswar 8 cm on 13th, Chandbali 10 cm and Balasore 7 cm on 14th and Contai 12 cm and Sagar Island 8 cm on 15th.

According to press reports, heavy rain and gales lashed the coastal districts of Ganjam and Puri, worsening the situation in the areas yet to recover from the previous month's cyclone and flood devastation. Road, rail and air communications were also paralysed.

### 13. Cyclonic storm in the Bay of Bengal - 12th to 17th December.

A low pressure area from the east moved into the south Andaman Sea on the 8th. Moving westwards, it lay over the southeast Bay of Bengal on the 10th. By the next day, it became well-marked and concentrated into a depression on the morning of 12th with centre at 0830 IST near  $5.5^{\circ}\text{N}$ ,  $90.5^{\circ}\text{E}$ . ESSA-6 satellite picture of 0859 IST of 12th showed Stage C+ system near  $5.5^{\circ}\text{N}$ ,  $90^{\circ}\text{E}$  with diameter of 2-3 degrees.

Moving in a northerly direction, it intensified into a deep depression with centre at 0830 IST of 13th near  $7.5^{\circ}\text{N}$ ,  $90.5^{\circ}\text{E}$ . ESSA-6 Satellite picture of 0946 IST of 13th showed a Stage X Cat. 2 system Diameter 3 degrees near  $7.5^{\circ}\text{N}$ ,  $90^{\circ}\text{E}$ . Taking a north-westerly course, the deep depression further intensified into a cyclonic storm by the evening with centre at 1730 IST near  $8.5^{\circ}\text{N}$ ,  $89.5^{\circ}\text{E}$ . There were no ships within three degrees of the centre of the system. However, Satellite Weather Bulletin issued by U.S. Weather Bureau, read "ESSA-7 Indian Ocean - 13/0830 GMT  $8^{\circ}\text{N}$ , Stage X diameter 3 Cat 3 eye dimly visible showing intensification". The cyclonic circulation associated with the system was extending upto 7.2 km a.s.l. at this time. Maintaining the northwesterly course, the cyclonic storm was centred near  $9.5^{\circ}\text{N}$ ,  $88^{\circ}\text{E}$  at 0830 IST of 14th. In this connection, the following observations of 14th are significant :

Name of ship/ station	Position		Time IST	Wind		Pressure (mb)	Weather
	Lat. $^{\circ}\text{N}$	Long. $^{\circ}\text{E}$		Direc- tion	Speed knots		
VWWP	10.6	88.5	0530	E	30	1004.6	Showers
UYSF	8.5	89.5	0530	SW	10	1006.2	Mainly overcast
VWMV	13.6	85.0	0530	NE	15	1013.6	Overcast
VWWP	10.6	88.9	0830	E	30	1007.3	Rain
VWWP	10.5	89.0	1130	ESE	30	1007.5	Rain
Jag Ratan	5.7	84.8	1130	NW	20	1012.9	Partly cloudy
Port Blair			0830	SE	20	1012.5	Thundershowers
Port Blair			0530	SE	20 at 300 m		
				SE	45 at 600 m		
				ESE	65 at 900 m		
				ESE	50 at 1500 m		

Continuing to move in a northwesterly direction it was centred near  $10.5^{\circ}\text{N}$ ,  $87^{\circ}\text{E}$  at 1730 IST of the same day near  $11^{\circ}\text{N}$ ,  $85^{\circ}\text{E}$  on the morning of 15th and near  $11.5^{\circ}\text{N}$ ,  $84^{\circ}\text{E}$  by the evening. Satellite weather bulletin from USA read as : "ESSA-7 - 15/0823 GMT,  $13^{\circ}\text{N}$ ,  $83^{\circ}\text{E}$  stage X Cat 2 diameter 3 - no eye discernible - weaker than yesterday". On the morning of 16th, the storm was centred near  $11.5^{\circ}\text{N}$ ,  $83^{\circ}\text{E}$ .

After 16th morning, the storm started to move in a southwesterly direction and was located near  $10^{\circ}\text{N}$ ,  $81^{\circ}\text{E}$  on the morning of 17th. By the evening of 17th, the storm weakened into a deep depression and was centred near  $9.5^{\circ}\text{N}$ ,  $80^{\circ}\text{E}$ . By the next morning, it weakened further and moving across the extreme south Peninsula, lay off Kerala coast and neighbourhood as a well marked low pressure area on 18th morning. By 20th, this low moved away westwards across southeast Arabian Sea.

From the Satellite pictures, the system could be classified as belonging to Stage X Cat 2 diameter 3-4 degrees which gives a maximum wind of 60 kt associated with the storm on 15th morning. According to Fletcher's formula, the lowest pressure works out to 996 mb with a pressure defect of 16 mb at 0830 IST of the same day.

Under the influence of this system, there was good spell of rainfall over the Bay Islands. Extreme south Peninsula also experienced widespread rainfall on 18th and 19th. The significant amounts of rainfall were : Kondul 7 cm and Nancowry and Hut Bay 6 cm each on 12th, Car Nicobar 7 cm and Hut Bay 5 cm on 13th, Turicorin 9 cm and Palamkottai, Atirampattinam, Vedaranniyam and Kodaikanal 6 cm each, Maya Bandar 5 cm on 15th and Madras 8 cm and Coonoor 5 cm on 19th.

TABLE II

Monthly distribution of cyclonic storms and depressions in the Bay of Bengal and Arabian Sea - 1968.

Month	Jan.	Feb.	Mar.	Apr.	May.	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Total									
Distur-	D	C	D	C	D	C	D	C	D	C	D	C	D	C								
bance	D	C	D	C	D	C	D	C	D	C	D	C	D	C								
Bay of Bengal	-	-	-	-	-	1(1)	1	-	1	-	3	-	-	2(1)	-	1(1)	-	2(1)	-	1	5	7(4)
Arabian Sea	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Land depression	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	1	-	-
Total	-	-	-	-	-	1(1)	1	-	1	-	3	-	-	2(1)	-	1(1)	-	2(1)	-	1	6	7(4)

D-Depressions

C-Cyclonic storms

Figures in brackets indicate severe cyclonic storms.

# TRACKS OF STORMS AND DEPRESSIONS (IN THE INDIAN SEAS)

1968

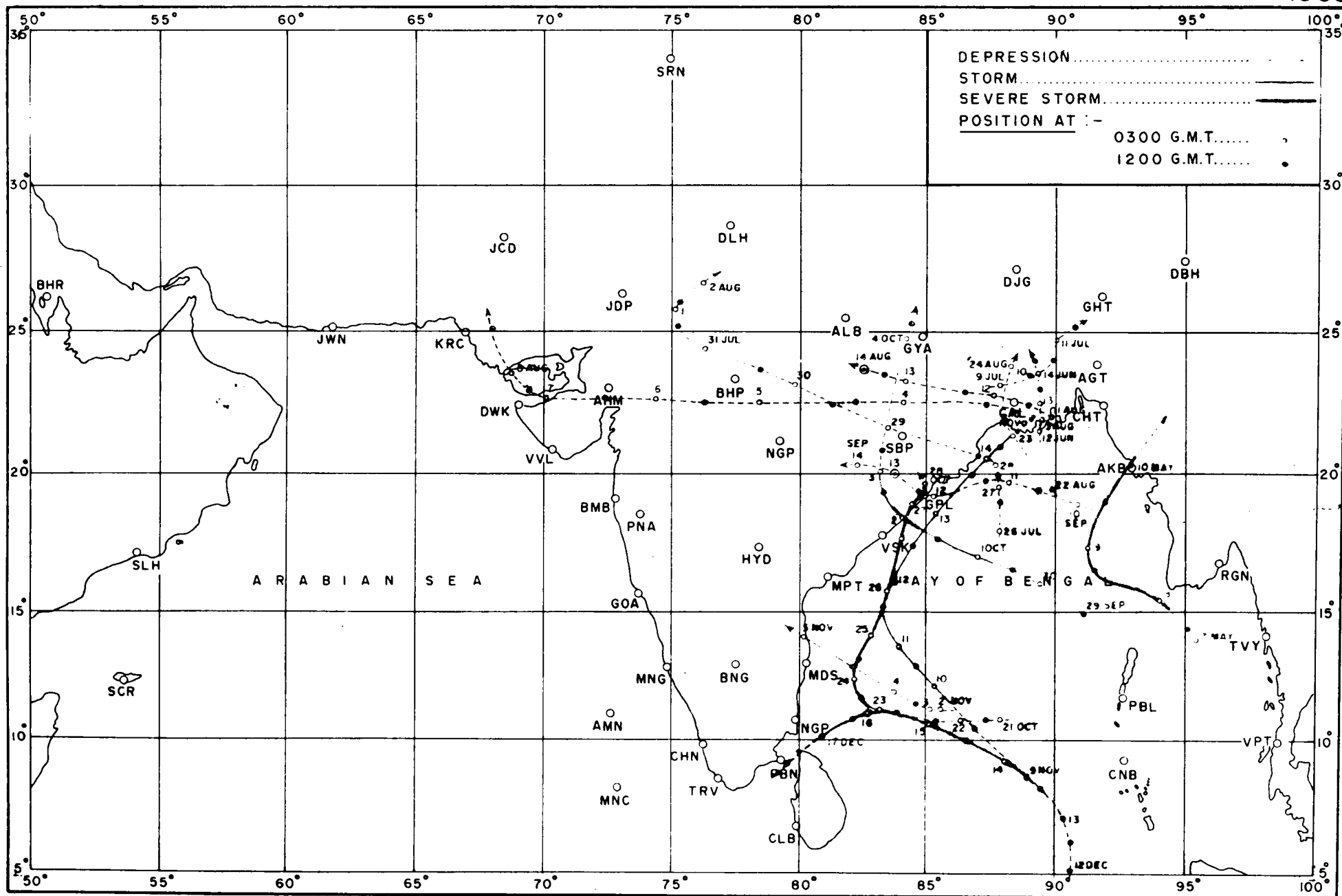


FIG. 1

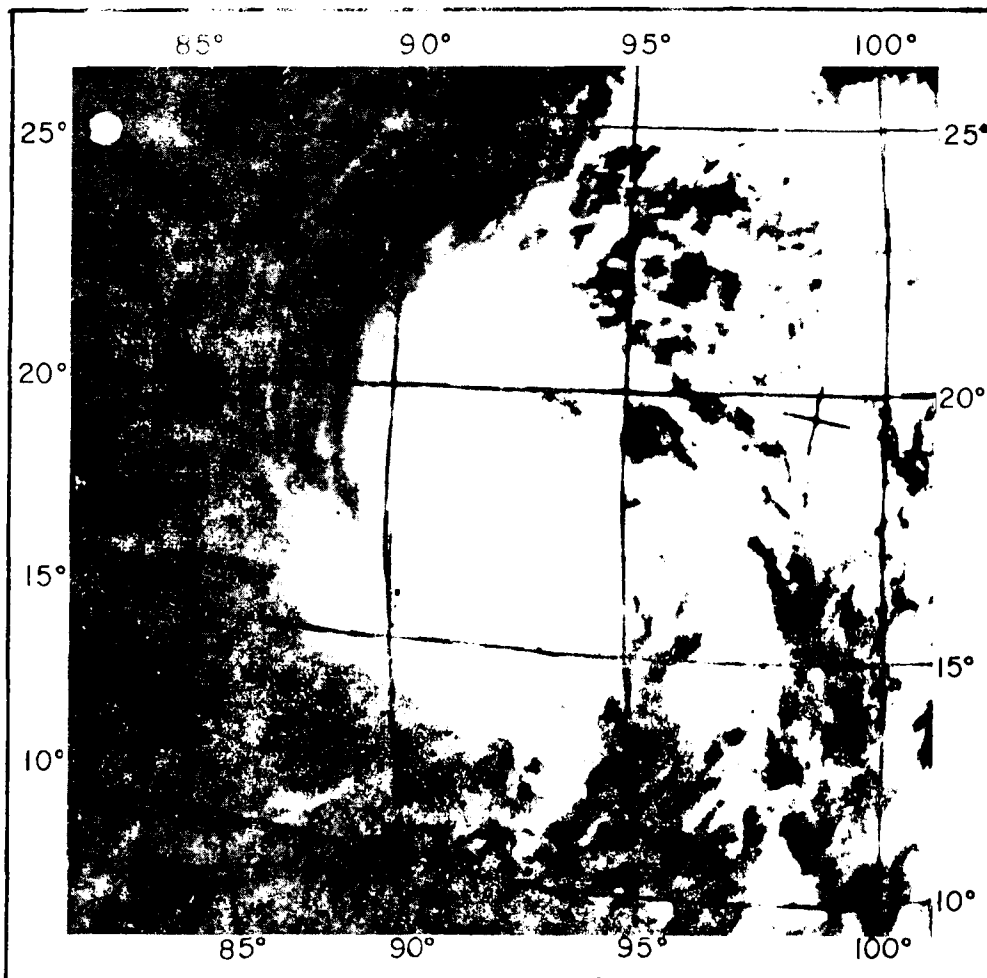


FIG. 2  
ESSA-6  
9 MAY 1968

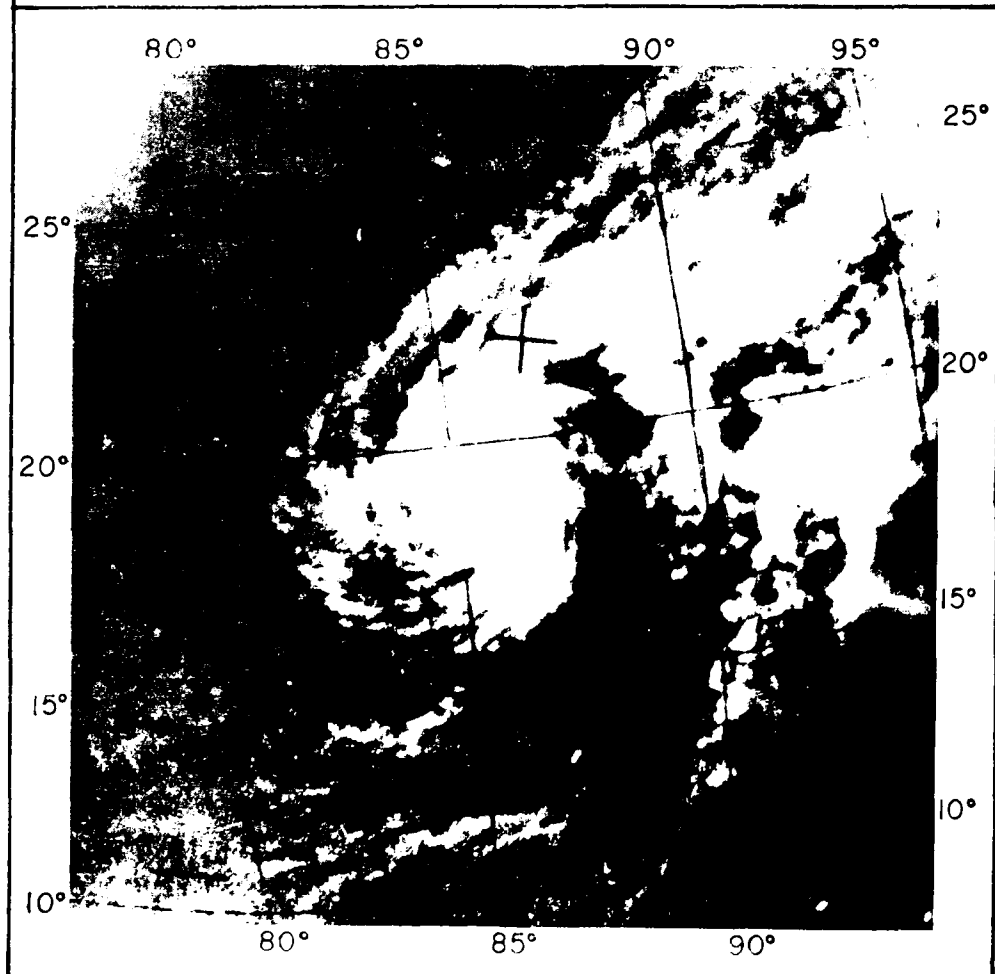


FIG. 3  
ESSA-6  
27 OCT. 1968

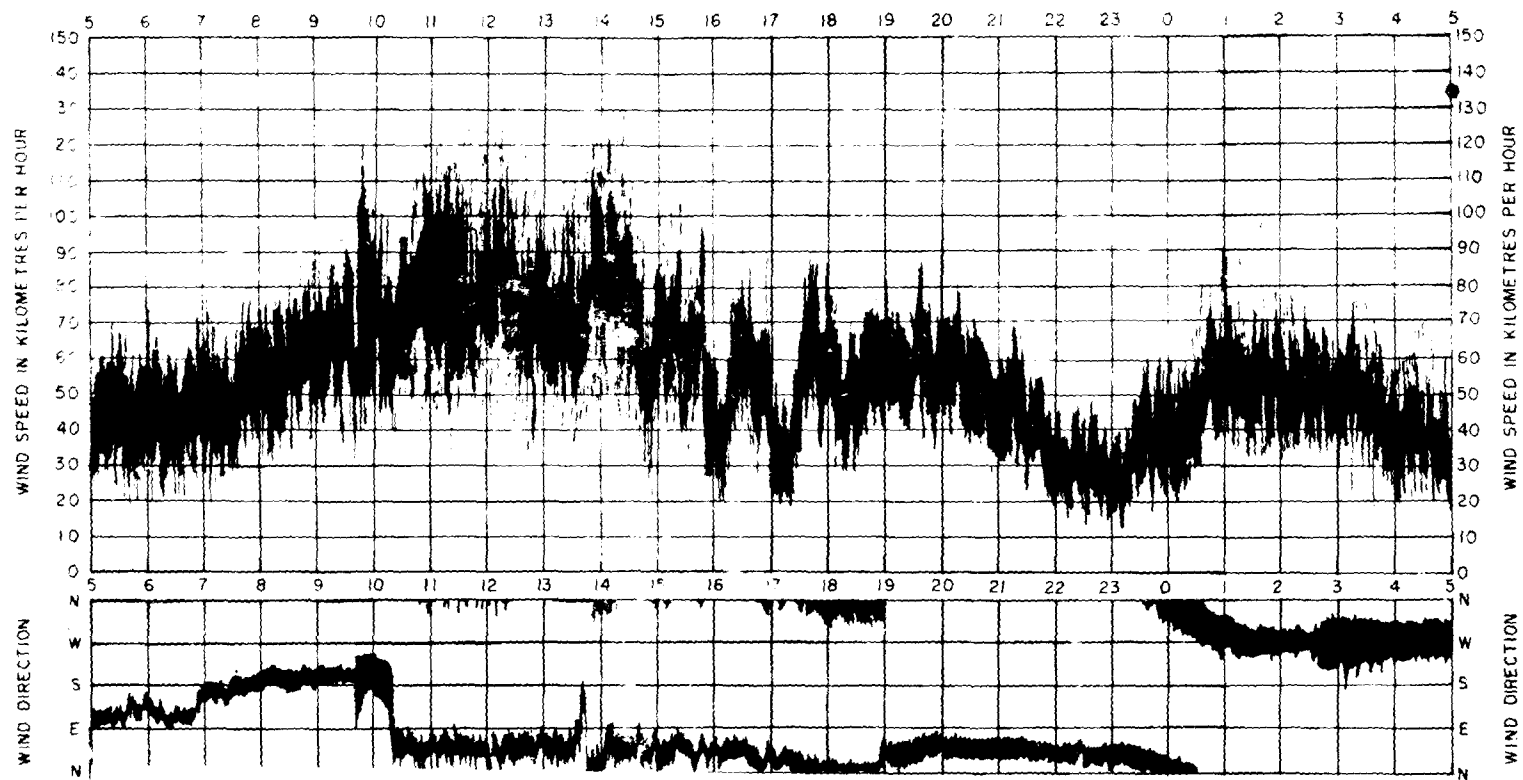


FIG - 4 ANEMOGRAM OF GOPALPUR OF 27-28 OCTOBER, 1968

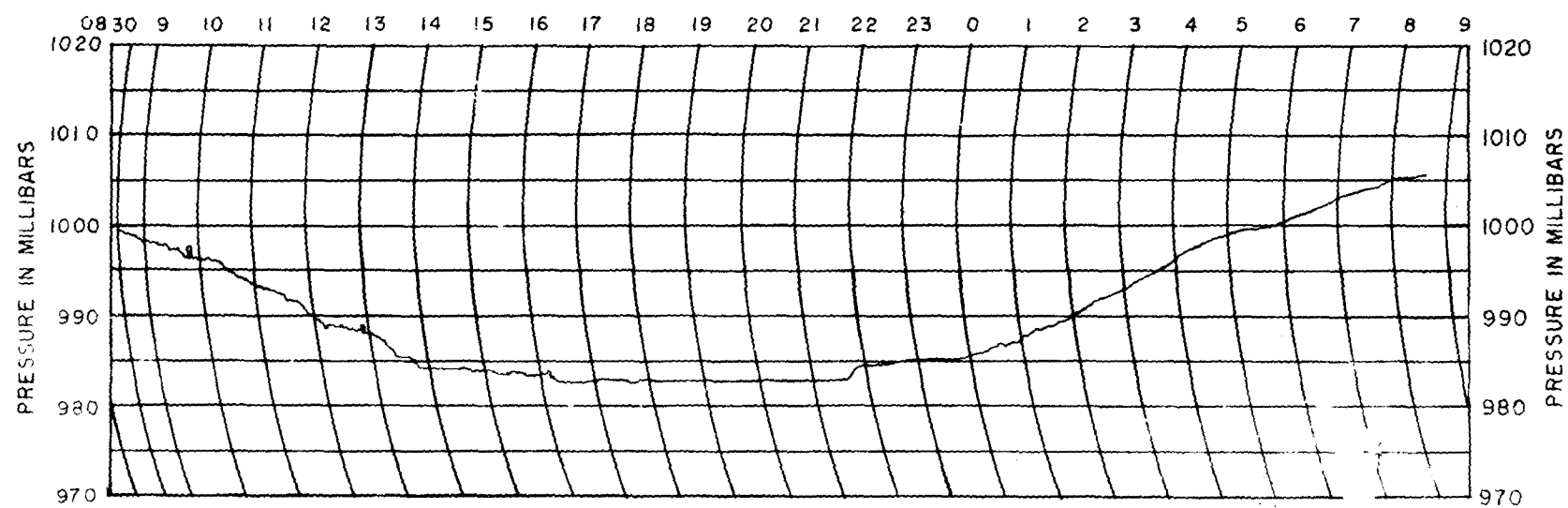


FIG-5 BAROGRAM OF GOPALPUR OF 27TH OCTOBER, 1968.